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forms of electric discharge from the clouds, it is none the less unsatisfactory to be told that atmospheric electricity arises from the earth's possessing a constant positive charge. Again: the theory that the sun is only one of a *chapelet de grains brillants* originally fused by a powerful current like the globules formed by a melting wire, and that "the incandescence of the solar globe, prolonged during a long series of ages, is itself only a spark of short duration in the infinity of time and space" (p. 250), is not worthy to stand in connection with the account of his many remarkable investigations. These furnish no basis for such a speculation, and scarcely more for the theory that "whirlwinds and cyclones are the powerful electro-dynamic effects produced by the combined forces of atmospheric electricity and terrestrial magnetism" (p. 229).

In conclusion, M. Planté says, respecting the nature of electricity, that it "may be considered as a motion of ponderable matter, — motion of transport of a very small mass of matter, animated by a very great velocity if an electrical discharge is considered, and a very rapid vibratory motion of the molecules of matter if its transmission to a distance under the dynamic form, or its manifestation under the static form, at the surface of bodies, is considered" (p. 314). Without adopting this view, we may say that many of Planté's experiments strongly support it.

THE CHILIAN LANGUAGES.

Chilidúgu sive tractatus lingue chilensis. Opera BERNARDI HAVESTADT. Editionem novam immutatam curavit Dr. JULIUS PLATZMANN. 2 vols. Lipsiæ, Teubner, 1883. 952 p. 12°.

THIS is the general title of Platzmann's neat facsimile reprint of an important publication of the eighteenth century which had become quite scarce. Havestadt was a Jesuit, born in the environs of Cologne, on the Rhine, and a man of considerable learning, — a fact which appears not only from the fluent and elegant Latin style in which his manuals are composed, but also from the few leaves which he devotes to an autobiographic notice. The travels performed by him (1751–52) in his Chilian diocese on the western slope and in the higher valleys of the Andes are described in vivid colors by himself, and illustrated by a quaint map, which fully deserves the attention of ethnographers. The missionary's work was originally published (in 1777) with several sub-titles, which are faithfully reproduced in the reprint with all the saints' images, heraldry, etc., and embrace the

following parts: Chilian grammar; three vocabularies; catechism, with Latin translation, and hymns in Chilian, to which music-notes are added; and a diary.

The phonetic system of Chilidúgu (*dúgu*, 'language') is described with laudable accuracy by the padre, who marks forty different sounds as constituting its alphabet. The language evinces some tendency towards nasalization of the consonantic elements, but is of an easy and harmonious pronunciation, and shows some general resemblance to Quichhua and Aymarà phonetics. A peculiarity not very often found in American languages is the dual, which here pervades the verb and pronoun as well as the noun. According to the custom of his epoch, Havestadt arranged the forms discovered in this southern language wholly after the pattern of the Latin grammar. He found six cases in the noun; but his paradigms conclusively show that his nominative is identical with his accusative and vocative, his dative the same form as his ablative. Whether these cases are formed by postpositions, or by real case-affixes, remains to be examined. The verb inflects with remarkable regularity, forms five tenses and an intricate array of verbals (nominal forms of the verb, gerunds, etc.), has an interrogative, affirmative, negative, and passive form, together with an extensive system of transitions. A large number of suffixes serves to form derivatives, verbal as well as nominal, from verbal and nominal bases. In his rich collection of conversational phrases, the author has given a powerful and safe guide for the study of this sonorous tongue, which he extols in such a manner as to make it "surpass in excellence and graphic power all other languages of the world." The vocabularies given by Havestadt are more copious than that of Febres and the other authors who have written upon the Chilidúgu. The dialect of Chilidúgu, treated by Havestadt, is that of the Molu-che tribe.

THE IRON AND STEEL INSTITUTE.

The journal of the Iron and steel institute. Vols. i. and ii. London, Spon, 1883. 10+484, 405 p. 8°.

THE proceedings of the Iron and steel institute cannot fail to be of interest to the general scientific public, and especially so to the workers and manufacturers of iron and steel, since the society numbers among its active members such men as Sir Henry Bessemer, Mr. Sidney G. Thomas, and Mr. I. Lowthian Bell. The late C. W. Siemens was one of the prominent members and contributors. The

papers read and discussed at the meetings held during the last fourteen years cover not only the practical, but the theoretical ground of the iron-manufacture.

As its name indicates, this society confines itself to the consideration of iron and steel, and allied subjects. In the volumes before us we have sixteen papers, which, with the discussions, occupy 389 pages. There are 43 plates of illustrations. The remainder of the volumes, 400 pages in all, consists of notes on the progress of the iron and steel industries of the United Kingdom and of foreign countries. These notes are arranged for the different countries under the following heads: ores and fuel, blast-furnace practice, manufacture of steel, manufacture of iron, mechanical and physical properties of iron and steel, chemical properties of iron and steel, statistics. These notes contain also summaries of important papers in foreign publications.

The most valuable papers in these volumes, those on the temperature best for the greatest production of iron at least expense of coke, and on coke and gaseous fuel, have been noticed already in *Science*, Nos. 33, 50, and 59.

Vol. i. opens with a discussion on Mr. G. J. Snelus's paper on the physical and chemical characters of iron and steel. In view of the great increase of attention paid to this subject, the points of the discussion are worth a moment's notice. One of the more important points to be settled is the relation of the chemical composition and the physical treatment, hammering, heating, compression, etc., to the toughness and durability of steel used for rails and machinery.

The first researches on the subject seem to have been those of Messrs. J. T. Smith and

Price Williams (*Proc. inst. civ. eng.*, 1875-76). The conclusion arrived at, that soft rails low in carbon resisted wear better than harder rails high in carbon, was contrary to the general opinion of metallurgists and engineers, which had been, that steel would wear better, the harder it was. C. B. Dudley's investigations in 1878 and 1880 (*Trans. Amer. inst. min. eng.*, vols. vii. and ix.) led him to advocate the use of soft steel for rails. The late Professor Grüner agreed with this view. But many engineers remained unconvinced; since, they argued, the rails tested might have had other causes of weakness than an unsuitable amount of carbon.

In the course of the discussion of Mr. Snelus's paper, M. Cazes, chief of the permanent way of the *Chemin de fer du midi de France*, gave some interesting tables, showing that the hard rails used on that road lasted much longer than those on the Cologne-Minden railroad, which have a composition more nearly approaching Dr. Dudley's proposed formula. There is as yet no commonly accepted measure of the work done by a rail. It is usually measured either by the tonnage borne or by the number of trains which have passed over it; but in nearly all estimates the speed of the train, which is an important element in the measure, has been left out of the consideration.

In view of all these discordant results, the physical side of the question is coming into prominence. It is said that a sudden cooling or a powerful compression favors the passage of the carbon into 'hardening carbon;' and upon this chemical effect of a physical cause, M. L. Clemandot's new process of tempering steel by compression is based. It is evident that many more experiments are needed before any satisfactory theory can be adopted.

INTELLIGENCE FROM AMERICAN SCIENTIFIC STATIONS.

GOVERNMENT ORGANIZATIONS.

Geological survey.

Microscopic rock-investigation. — In addition to the microscopic examination of thin rock-sections being made in the various divisions of the survey, especially in the Rocky-Mountain division at Denver, and by Mr. R. D. Irving and his assistants in the Lake-Superior region, arrangements have been perfected to carry on similar work at Washington, under the direction of Mr. J. S. Diller, who has recently been engaged in arranging the machinery and appliances for this work. The work of cutting and grinding rock-specimens has been carried on by Mr. Newman,

under the immediate supervision of Mr. Diller. It is also intended, in this connection, to make the photographic division available; and preparatory measures, with this object in view, are being taken by Mr. Hillers, the photographer of the survey.

Rocks of Lassen's Peak. — Last July Mr. Diller, before undertaking the reconnoissance of the Cascade Range, made a six-days' trip from Red Bluff, California, to Lassen's Peak (or Butte), and collected a number of interesting rocks; and of these Mr. Newman made thin sections, the microscopic study of which occupied Mr. Diller's time during January. They included basalts, hypersthene andesites, hornblende andesites, dacites, and basaltic and andesitic tufas.